

# **Leque Island Design Alternatives Analysis Narrative**



Analysis By: Washington Department of Fish and Wildlife (WDFW) Region 4 Staff and Ducks Unlimited

Design To Be Selected By: WDFW

Input Provided By: Leque Island Stakeholder Advisory Committee and from the public via survey

**April 2015**

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## Purpose of this Document

This document is meant to summarize an analysis completed by Washington Department of Fish and Wildlife (WDFW) and Ducks Unlimited (DU) for each of the design alternatives advanced in the Leque Island Alternatives Analysis and Design Project. This analysis is meant to inform selection of the preferred alternative design for Leque Island by WDFW. Input from a Stakeholder Advisory Group consisting of recreationists, local citizens, jurisdictions, tribal staff, and other interested parties, as well as information gathered through public surveys and a meeting with Tribal policy representatives contributed to this analysis.

## Executive Summary

Leque Island is a unit of the Skagit Wildlife Area, which is owned and managed by Washington Department of Fish and Wildlife (WDFW). Leque Island is a historic 450 acre salt marsh island at the delta of the Stillaguamish River situated between Puget Sound mainland and Camano Island, as well as Port Susan Bay to the south and Skagit Bay to the north. In the late 1800's/early 1900's, local settlers built perimeter dikes and drainage structures to convert the historic salt marsh to agricultural use. WDFW started purchasing the Island which is comprised of approximately 9 parcels in 1974. Today it consists of wetlands and diked agricultural fields. Contract farmers annually plant cereal grain as food for wintering waterfowl (mainly ducks and snow geese). This site offers bird watching, bird dog training, and pheasant and waterfowl hunting, as well as other recreational opportunities. Washington State Department of Transportation (WSDOT) maintains Highway 532, which bisects Leque Island and provides the only road access to Camano Island.

Much work has been done regarding feasibility and design of varying degrees of tidal restoration on the Island, as it is identified as a top priority in many conservation plans and the perimeter dikes are in a state of disrepair. Most recently, the perimeter dikes failed and naturally breached in two locations in 2010. Emergency temporary repairs were implemented to protect the highway, private inholdings, and WDFW-owned parcels from tidal inundation. These repairs were authorized by the U.S. Army Corps of Engineers (Corps) in a permit with a condition that required their removal within 27 months of installation, which has since been extended until May 2016. Since implementation of the temporary repairs, WDFW has acquired all private inholdings and WSDOT has initiated construction on a project to raise and armor Highway 532 so that it will not require a dike for protection in the future. This has culminated in an opportunity to examine new design options for Leque Island, with some urgency applied through the expiring temporary permit from the Corps.

WDFW and Ducks Unlimited (DU) formed a partnership, received grant funding, and launched the Leque Island Alternatives Analysis and Design Project (Project) in 2013. The intent of the Project is to select a design alternative that will be a long term solution to the failing dikes, while also benefitting habitat and considering impacts to recreational opportunities. Several opportunities for stakeholders, the public, and co-managers were organized throughout the Project (Appendix A).

WDFW held a public open house on October 30, 2013 to launch the Project. At this open house and through a survey, WDFW solicited volunteers to participate in a Stakeholder Advisory Committee (Committee). Through this process, 30 people volunteered to participate on the Committee, and all were invited to participate in three subsequent meetings over the following year. The volunteers consisted of recreationists, local citizens, jurisdictions, tribal staff, restoration groups, and other interested parties.

A major goal of the Committee was to provide input regarding which design alternative concepts should be advanced for consideration as the possible preferred design for Leque Island. Consistent with input provided by the Committee, WDFW decided to advance a full array of design concepts for consideration. In total, six design alternatives ranging from no tidal restoration on the site to full tidal restoration of the site were developed. Ducks Unlimited provided designs for these concepts, and they were advanced for hydrodynamic modeling that was necessary to analyze each of the design alternatives.

WDFW drafted a set of design selection criteria to be used to inform selection of the preferred design alternative (Appendix B). The selection criteria were modified with input from the Committee and then finalized. WDFW and DU then developed a rating system to summarize the analysis of each criterion among all six design alternatives. The rating system is intended to provide a summary of how WDFW expects each criterion will be impacted by each design alternative. WDFW and DU drafted initial ratings for each design among the selection criteria, which were then reviewed by Committee (Appendix C). The Committee provided input on the ratings prior to finalization.

After the final Committee meeting, WDFW sought input from each Committee member on their preferred design alternatives among the six under consideration. In total, 20 of the 34 members of the Committee provided input. The majority of Committee members favored design options that involved restoring tidal flows and estuary habitat to the entirety of Leque Island.

WDFW and DU hosted a final public open house for the Project on February 25<sup>th</sup>, 2015 to present results of the design alternatives analysis and Committee processes, and to gather additional input from people who elected to not participate on the Committee. On April 1<sup>st</sup>, 2015, WDFW met with Tribal policy representatives to collect final input prior to recommending the preferred design alternative.

Information compiled in this report and appendices was used to inform WDFW's selection of the preferred design alternative. Once the preferred design alternative is selected by WDFW, it will be announced in a memorandum that will be posted on the project webpage.

## **Project Introduction**

### ***Background***

Leque Island is a unit of the Skagit Wildlife Area, which is owned and managed by Washington Department of Fish and Wildlife (WDFW). Leque Island is a historic 450 acre salt marsh island at the delta of the Stillaguamish River situated between Puget Sound mainland and Camano Island, as well as

Port Susan Bay to the south and Skagit Bay to the north. Between the late 1800's and early 1900's, local settlers built perimeter dikes and drainage structures to convert the historic salt marsh to agricultural use. Highway 532 bisects the Island, and is maintained Washington State Department of Transportation (WSDOT). WDFW started purchasing the Island which is comprised of approximately 9 parcels in 1974. Today it consists of wetlands and diked agricultural fields. Contract farmers annually plant cereal grain as food for wintering waterfowl (mainly ducks and snow geese). This site offers bird watching, pheasant and waterfowl hunting, bird dog training, and other recreational opportunities.

Much work has been done in the past regarding feasibility and design of varying degrees of tidal restoration on the Leque Island, as it is identified as a top priority in many conservation plans. Restoration of estuary habitat on Leque Island through removal of the dikes is identified as the highest priority project in the Stillaguamish Chinook Recovery Plan to benefit Chinook salmon, which are listed as threatened under the Endangered Species Act. As juvenile salmon migrate from the Stillaguamish River into Port Susan Bay, estuary habitat provides valuable refuge and food sources until the salmon reach a size that they are less vulnerable to predation and migrate into open water. Because of the close proximity of Leque Island to the Stillaguamish River and the ground elevation of the Island landward of the dikes, the area could feasibly be converted to estuary habitat that would be valuable to recovery of salmon species. Many monitoring projects and reports, including the North Puget Lowlands Report authored by the Pacific Coast Joint Venture indicate that estuary habitat is also valuable to many species of shorebirds and waterfowl.

In 2009, the project partners proposed and developed a 115 acre tidal project with a setback levee and enhanced freshwater wetlands behind the levee and restored estuary. That project was ultimately opposed and halted due to saltwater intrusion concerns to an adjacent drinking water aquifer on Camano Island. The Environmental Protection Agency (EPA) intervened, the project partners conducted a year-long groundwater study, and EPA made a final determination that tidal restoration of Leque Island would not negatively impact the drinking water aquifer.

In the interim of the groundwater study scoping and planning efforts, the perimeter dikes failed and naturally breached in two locations in 2010. Emergency temporary repairs were implemented to protect the highway, private inholdings, and WDFW-owned parcels from tidal inundation. These repairs were authorized by the U.S. Army Corps of Engineers in a permit with a condition that required their removal within 27 months of installation. WDFW has since been granted an extension to leave the temporary repairs in place until May of 2016 while a permanent solution is planned.

Since installation of the temporary dike repairs, WDFW purchased the remaining private inholdings and demolished all structures. Simultaneously, WSDOT built a new, taller, wider highway bridge and is currently implementing a project to raise and armor the highway so that it does not require a dike for protection. All of this has culminated in an opportunity to re-examine the design options for Leque Island, including the possibility of expanding the scope of the tidal project to include most of the 250 acre portion of the Island that is south of SR 532.

The project partners received grant funding and launched the Leque Island Alternatives Analysis and Design Project in 2013. The intent of this project is to select a design alternative that will be a long term solution to the failing dikes, while also benefitting habitat and considering impacts to recreational opportunities. Several opportunities for stakeholders, the public, and co-managers were organized throughout the Project (Appendix A).

### ***Design Alternatives Development Process***

WDFW held a public open house on October 30, 2013 to launch the Leque Island Alternatives Analysis and Design project. At this open house and through a survey, WDFW solicited volunteers to participate in a Stakeholder Advisory Committee (Committee). Through this process, 30 people volunteered to participate on the Committee, and all were invited to participate in subsequent meetings. The volunteers consisted of recreationists, local citizens, jurisdictions, tribal staff, restoration groups, and other interested parties.

A major goal of the Committee was to provide input regarding which design alternative concepts should be advanced for consideration as the possible preferred design for Leque Island. Consistent with input provided by the Committee, WDFW decided to advance a full array of design concepts for consideration. In total, six design alternatives ranging from no tidal restoration on the site to full tidal restoration of the site were developed. Ducks Unlimited provided designs for these concepts, and they were advanced to Pacific Northwest National Laboratories (operated by Battelle) for hydrodynamic modeling that was necessary to analyze each of the design alternatives.

### ***Design Selection Criteria Overview and Key***

WDFW developed a set of design selection criteria to be used to inform selection of the preferred design alternative. These criteria were developed into two distinct categories; the “Screening Criteria” and “Additional Considerations”. Screening Criteria were criteria that WDFW considered to be required to be met in order for a design concept to be considered for selection as the preferred alternative. Additional Considerations were criteria that WDFW and the Stakeholder Advisory Committee (Committee) considered to be important factors to take into consideration when selecting the preferred design.

After WDFW drafted a list of Screening Criteria and Additional Considerations, the draft list was presented to the Committee. The Committee provided input into which additional considerations should be added to the list, and WDFW added the Committee’s recommendations. A list of the Screening Criteria and Additional Considerations is available in Appendix B.

WDFW and DU developed a rating system to apply each criterion to each of the six design alternatives. The rating system is intended to provide a summary of how WDFW expects each criterion will be impacted by each design alternative. The ratings assigned to each design for each criterion is in relation to the existing condition of the site. The rating system is meant to be an evaluation tool to inform selection of the preferred alternative design by WDFW, and is not meant to be used as a numeric scoring system that will be used to automatically select the preferred design.

The following is a key of the rating system:

**Key \***

Substantial Positive Change	+ +
Positive Change	+
Some positive effects, some negative effects, overall minimal or no net change in value	+/-
Comparable to Existing Conditions	√
Negative Change	-
Substantial Negative Change	- -

\* all changes are relative to existing conditions

***Hydrodynamic Model Overview***

Ducks Unlimited (DU) engaged Pacific Northwest National Laboratory (PNNL) to develop a three-dimensional hydrodynamic model of Port Susan Bay, Skagit Bay, and the interconnecting Leque Island region for use in support of the feasibility assessment for the Leque Island Alternatives Analysis and Design Project. In this effort, DU also included a potential future Stillaguamish Tribe project on a nearby property called “zis a ba”. The objective of this modeling-based feasibility assessment was to evaluate the performance of proposed restoration actions in terms of achieving habitat goals while assessing the potential hydraulic and sediment transport impacts to the site and surrounding parcels of land.

For this effort, PNNL developed a three-dimensional hydrodynamic model for the Leque Island and zis a ba restoration sites based on an existing model of the system including Skagit Bay and Port Susan Bay. The model was used to simulate tidal inundation, salinity, velocity, and bed shear stress in the study area for six proposed design scenarios at Leque Island, with additional scenarios included for the Stillaguamish Tribe property. These included one scenario with no restoration at Leque Island, two restoration scenarios with dike breaches at Leque Island, three scenarios with dike removal at Leque Island, and three scenarios with dike removal at zis a ba in combination with the scenarios at Leque Island.

The overall conclusion based on examination of the results is that restoration of estuarine functions and marsh habitat is feasible through the proposed actions at the Leque Island and zis a ba sites. The two

projects do not appear to significantly impact one another. Specific conclusions based on model simulation results for Leque Island are briefly described below.

- Restoration of estuarine functions to Leque Island in all restoration areas in the various scenarios appears to be feasible based on simulation results.
- Leque Island restoration scenarios involving full dike removal would result in alteration of estuarine exchange pathways between the Stillaguamish River and the restoration area. High levels of bed shear stress and erosion are predicted over the interior drainage channels and at dike breach openings. Further, some level of increased velocity and bed shear is predicted on the east side of the Stillaguamish River, opposite the restoration area.
- Intertidal processes (ebb and flow of tides) would be restored to all areas. Tidal inundation would be between 20-60% of the time depending on bed elevation.
- Scenarios involving dike breaching (as opposed to full dike removal) resulted in some muting of tidal flow.
- Salinities are predicted to be in the range of 5-15 ppt  $\approx$  92% of the time at representative locations for most scenarios. This salinity range is consistent with the desired range for estuary salmon habitat.
- Velocities  $<0.48$  m/s and bed shear  $<0.5$  Pa are predicted to occur over  $\approx$  90% of the time at representative locations.
- The highest water-surface elevations for the restoration sites were predicted for winter months (December 25, 2003) during which Puget Sound is subjected to highest incoming tides from the Pacific Ocean. The water levels during this period overtopped the higher grounds on the western side of Leque Island and connected with Davis Slough.

Application of the model to the respective scenarios provided several insights on system response to proposed changes. Examination of the simulation results for the typical estuarine conditions of October 2005 leads to the overall conclusion that all restoration scenarios at Leque Island and zis a ba considering removing or breaching of the dikes would result in immediate tidal response and restoration of estuarine functions in the Leque Island and zis a ba project sites.

While the simulation results suggest that all scenarios are feasible, the report suggests that additional study be undertaken after the preferred scenario is selected. In this additional study, specific points of interest will be identified in the Stillaguamish River channel and the model will be reapplied to more closely examine velocities and bed shear forces in the vicinity of adjacent properties. This work will be completed in the subsequent design and study phase for the project.

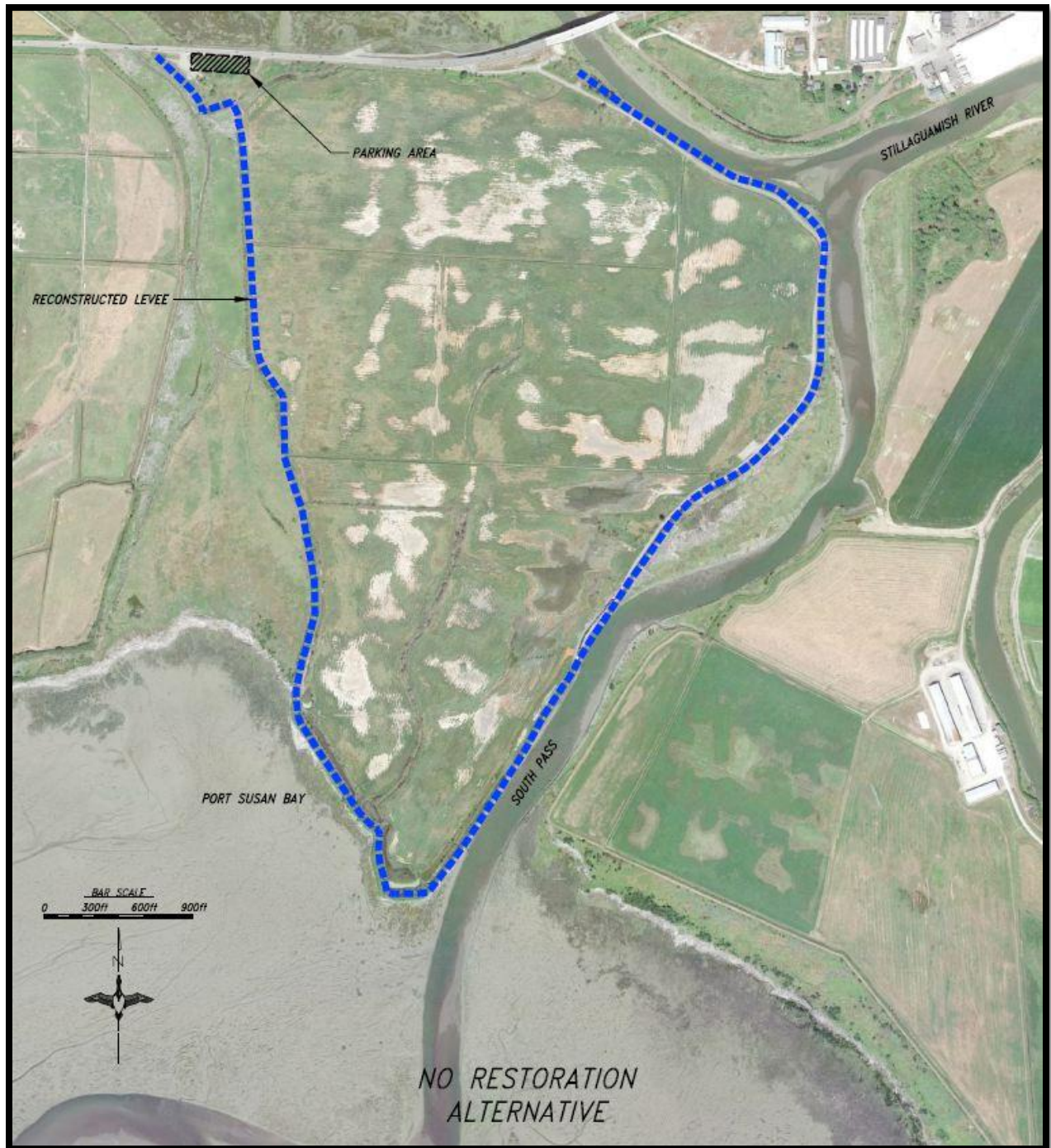
Much of the preceding information was copied from a report titled *Hydrodynamic Modeling Analysis for Leque Island and zis a ba Restoration Feasibility Study*, which was produced by Pacific Northwest National Laboratories and authored by TP Khangaonkar and JM Whiting in January 2015. The entire



report is available on the project webpage at:

[http://wdfw.wa.gov/lands/wildlife\\_areas/skagit/leque\\_island\\_project.php](http://wdfw.wa.gov/lands/wildlife_areas/skagit/leque_island_project.php).

## No Restoration Alternative (Scenario 0 in the Modeling Report)



### ***Design Description***

The “No Restoration” design alternative involves rebuilding the levee in its current footprint, or as near as possible to the current footprint, around the perimeter of Leque Island that is south of Highway 532.

This design assumes that access facilities and public recreation opportunities would remain the same, or very similar to the current state. There is no tidal restoration element in this design alternative.

### ***Screening Criteria Analysis***

#### ***Funding Source Potential – Highly Unlikely***

The cost estimate for constructing this alternative is \$10.5 million, not including permit and compensatory mitigation costs. This estimate is very preliminary, as details influencing cost would be determined in the subsequent design phase. WDFW has not identified an external grant fund source that would be willing and has the capacity to fund this alternative. The only possible mechanism identified that could fund this alternative is by requesting to add the project to the State Capitol Budget that is approved by the legislature biannually. In order for this to be successful, the project would need to be prioritized highly enough among other State projects and the cost would need to be justified. Given past experience with State Capital Budget requests, as well as cost efficiency and availability of external grant sources for other design alternatives, it is highly unlikely that this request would be successful.

#### ***Permit Potential – Very Expensive***

Permits required to construct this design alternative would be contingent upon constructing an approved compensatory mitigation project to mitigate the loss of estuarine wetland displaced by the footprint of the new levee system. The new levee system would measure approximately 2.3 linear miles. The width of the new levee system would be greater than the existing levee system by at least 20 feet over the entire length of the levee in order to achieve the necessary height of the new levee at acceptable side slope grades. This would result in at least 5.6 acres of estuarine wetland displaced by the new levee system. Because there is no estuary restoration element to this project, the compensatory mitigation project would need to be constructed at an off-site location. Cost estimates for estuarine wetland mitigation vary widely, though can range from \$100,000 - \$750,000 per acre. Without an identified grant fund source that is willing to pay for compensatory mitigation, this permitting cost is likely prohibitive to building this design alternative.

#### ***WDFW Contractual Obligations – Compatible***

Because land use on the site is not projected to change, implementation of this design alternative is compatible with all contracts associated with the original fund sources associated with the property acquisitions of Leque Island.

#### ***Neighboring Property Impact – None***

As the configuration of the levees will remain nearly the same as the baseline condition, no negative impacts to neighboring properties are projected.

***Screening Criteria Result: (Eliminated or **Advanced\***)***

\* Note: This alternative is advanced for analysis in the Additional Considerations criteria, though as described in the Screening Criteria, it is highly unlikely that implementation of this alternative is possible.

### ***Additional Considerations Analysis***

#### ***Salmon Habitat Availability (v)***

No change from current condition.

#### ***Other ESA-listed Species Habitat Availability (v)***

No change from current condition.

#### ***Non-ESA listed Species Effects (v)***

No change from current condition.

#### ***Property Maintenance (+)***

This project would provide a new and improved dike and levee system that would reduce the current dike repair cost. Dike maintenance costs would become part of the Wildlife Area operation and management budget and would include vegetation management, weed control and monitoring infrastructure. These costs would continue to exist long-term and be necessary to protect the infrastructure, as well as costs associated with maintaining the site in its current configuration. The site is managed to provide natural and agricultural enhancements for waterfowl and to provide hunting opportunities for the Western Washington Pheasant Release program. This work is accomplished by Wildlife Area Staff and a local sharecrop farmer and is funded by State Migratory Bird Stamp and State Non-PR funding.

#### ***Natural Processes Restored (v)***

No change from current condition.

#### ***Compatibility with Climate Change (v)***

No change from current condition.

#### ***Waterfowl Hunting Opportunity and Access (v)***

No change from current condition.

#### ***Pheasant Hunting Opportunity and Access (v)***

No change from current condition.

#### ***Wildlife Viewing and Photography Opportunity and Access (v)***

No change from current condition.

#### ***Dog Training Opportunity and Access (v)***

No change from current condition.

***Educational and Research Opportunity (v)***

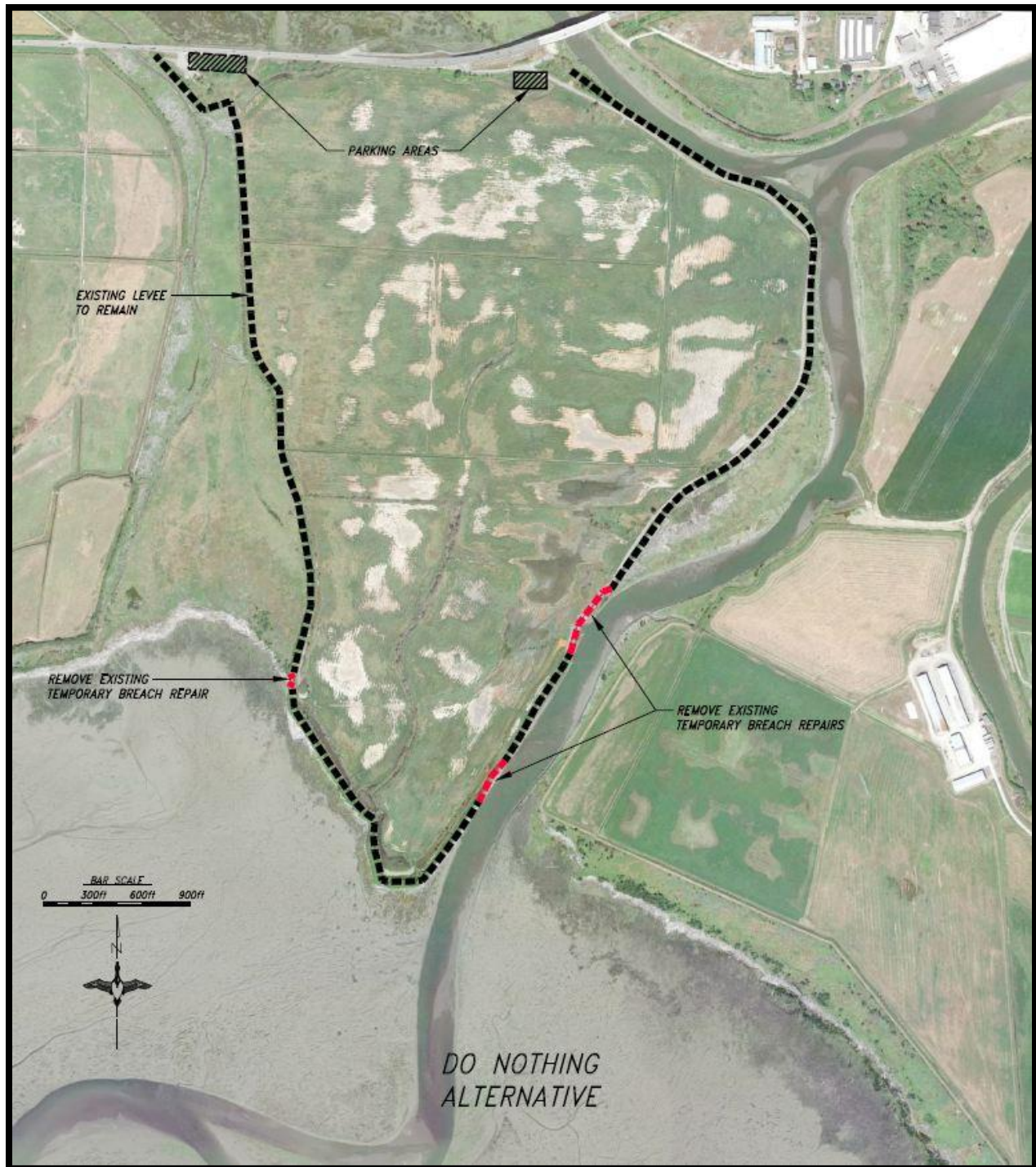
No change from current condition.

***Salmon Recovery Consistency: (No)***

This design alternative does not contribute towards goals outlined in the *Stillaguamish Watershed Chinook Salmon Recovery Plan* (June 2005).



## Do Nothing Alternative (Scenario 8 in the Modeling Report)



### ***Design Description***

The “Do Nothing” design alternative includes leaving the current levee system in place around the perimeter of Leque Island that is south of Highway 532, with the exception of the materials installed as temporary repairs in 2010. Per the permit issued by the U.S. Army Corps of Engineers that allowed

installation of the temporary repairs, the repair materials must be removed by May of 2016 if a long-term plan for Leque Island is not developed. In this design alternative, the entire site would be open to tidal inundation, though tidal processes would be muted due to the relatively small openings in the levee system where the temporary repairs would be removed. Over time, the openings in the levee system would likely expand and the degree of tidal muting would decrease. Two parking areas could be developed adjacent to Highway 532, if funding secured to complete the project is able to cover this cost.

### ***Screening Criteria Analysis***

#### ***Funding Source Potential – Highly Likely***

The cost estimate for constructing this alternative is \$220,000, not including permit and compensatory replacement land costs. This estimate is very preliminary, as details influencing cost would be determined in the subsequent design phase. Due to consistency with salmon recovery priorities and the low cost of constructing this design alternative, it is highly likely that external grant sources dedicated to salmon and habitat recovery would fund implementation.

#### ***Permit Potential – Low Cost***

No significant costs or barriers to receiving permits to implement this design alternative are foreseen at this time. This project is consistent with permit provisions outlined by the Army Corps of Engineers as part of the authorization to install the temporary repairs in 2010.

#### ***WDFW Contractual Obligations – NAWCA Replacement Lands***

In 1993, WDFW was awarded a grant through the North American Wetland Conservation Act (NAWCA) administered by the U.S. Fish and Wildlife Service (USFWS) to acquire properties in Skagit County. As part of that grant award, WDFW used a portion of Leque Island as leverage or “match” in order to receive the NAWCA grant. Language in the grant contract between WDFW and USFWS indicates that the portion of Leque Island used as match for the NAWCA grant shall remain as farmed forage for snow geese unless otherwise approved by NAWCA. This design alternative would not allow WDFW to continue to plant snow goose forage on the portion of Leque Island used as NAWCA match. At this time, NAWCA personnel have indicated that implementing this design alternative will require WDFW to provide a long-term replacement for snow goose forage on a property within a reasonable vicinity and comparable acreage to the NAWCA match properties. At the time of construction, WDFW would need to have a plan in place and timeline for providing this replacement.

#### ***Neighboring Property Impact – None***

A study completed by Pacific Groundwater Group in 2012 titled “A Hydrogeologic Evaluation of Proposed Restoration of Leque Island”, and subsequent confirmation from the U.S. Environmental Protection Agency (EPA) indicate that implementation of this design alternative does not increase risk to adjacent drinking water aquifers. WDFW and DU are continuing to monitor water quality parameters as requested by Juniper Beach Water District, and will continue to do so if this alternative is selected for implementation.

Results from the initial hydrodynamic model indicate that there is nothing of obvious concern that would eliminate this design from consideration. If this design is selected, specific points of interest will be identified in the Stillaguamish River channel and the model will be reapplied to more closely examine velocities and bed shear forces in the vicinity of adjacent properties. This work will be completed in the subsequent design and study phase for the project.

**Screening Criteria Result:** (Eliminated or **Advanced**)

### ***Additional Considerations Analysis***

#### ***Salmon Habitat Availability (+)***

Results of the hydrodynamic model indicate that the entire site would be inundated by tidal water for amounts of time desirable for salmon rearing at desired salinity levels, which is an improvement over the current site condition. However, the relatively small openings in the levee limit salmon accessibility to the site and would mute habitat forming processes, especially channel formation. Channels and habitat connectivity are important for salmon rearing, thus this design did not receive the highest possible rating in this category.

#### ***Other ESA-listed Species Habitat Availability (+)***

For the purpose of this document, there are four species listed as threatened or endangered in the Endangered Species Act (ESA) with the potential to be impacted directly or indirectly by this project. They are steelhead, bull trout, marbled murrelet, and orca whales. The increase in area of estuary habitat provided by this design is more beneficial to these species than the current condition of the site. The impaired accessibility to the site due to the small openings in the breaches prevents this alternative from receiving the highest rating.

#### ***Non-ESA listed Species Effects (+/-)***

Restoring tidal flooding to the site will provide habitat for a different suite of species than the current conditions. Upland species will likely be displaced to other sites, while species adapted to estuary conditions will expand onto the site. As a result, this alternative was given neither a positive or negative value. It is also understood that conditions will not be comparable to the existing state of the site, so a  $\sqrt{}$  value is not appropriate. A +/- rating is assigned because there are positive effects for some species and negative effects for others, and it is assumed that there is no definite overall positive or negative net effect.

#### ***Property Maintenance (-)***

A monitoring and adaptive management plan would need to be developed to identify action points for maintenance of this design. Fish monitoring and vegetation monitoring would be helpful to ensure that beneficial habitat conditions exist and that invasive plant species do not dominate the system. Because the degree of tidal restoration would likely shift over time as the breaches expand, property maintenance activities may need to shift over time to adapt to changing conditions.



The modification to existing infrastructure such as the removal of hardened features such as the Eide Road parking, county road way and drainage ditches have not been examined so no costs have been determined. The costs associated with the monitoring and adaptive management measures have not been developed for this alternative but would be discussed if this design is chosen to move forward to implementation.

***Natural Processes Restored (+)***

The hydrodynamic model indicates that hydraulic tidal processes would be restored to the entire site, though tidal processes would be muted in the short term due to relatively small openings in the levee. In addition to hydraulic processes simulated by the model, other natural processes need to be considered under this criterion. Several studies and scientific documents, including the 2013 WDFW Water Crossing Design Guidelines, indicate that geomorphic and sedimentary processes are affected by the size of dike breach openings. Some of these natural processes include sediment transport, large wood accumulation, and channel migration. Restoration of these underlying natural processes is necessary to maintain desired habitat structures and functions in the long-term, including a dynamic network of channels, marsh vegetation, and complex large wood structures. This alternative presents an improvement compared to current conditions, though it does not receive the highest possible rating because of muted effects in natural processes due to the relatively small breach openings.

***Compatibility with Climate Change (+)***

The existing levees on the site overtop occasionally, and will continue to overtop with more frequency according to models that project sea level rise. This alternative presents an improvement over the current condition because there WDFW would no longer attempt to restrict tidal flows from the site using the existing undersized levees. The alternative does not receive the highest possible rating because portions of the remaining levee would remain on site.

***Waterfowl Hunting Opportunity and Access (+/-)***

The site would remain open to waterfowl hunting, and the estuary habitats projected to form on the site over time are important habitats for waterfowl. Recent studies have indicated that restoration of estuary habitat significantly benefits waterfowl populations. Hunting access on the property would shift from walk-in field hunting to walk-in or boat-in intertidal estuary hunting. Depending on the style of hunting preferred by an individual waterfowl hunter, this change could be seen as a positive or negative impact to hunting opportunity and access.

***Pheasant Hunting Opportunity and Access (- -)***

Because of the restoration of tidal inundation on the entire site, the site would no longer be able to support pheasant releases and hunting. WDFW will work to identify and secure an alternative site that can be used for pheasant hunting.

***Wildlife Viewing and Photography Opportunity and Access (-)***

Wildlife viewing and photography opportunities will still be available on the site however, with the shift in habitat to estuarine conditions on the entire site, species that prefer upland habitats would no longer be present as consistently on the site. Walk-in access would be limited to sections of the dike that are not removed, though boat-in access may provide unique viewing and photography opportunities and some walk-in access may be possible on the site depending on the tide level.

***Dog Training Opportunity and Access (–)***

The site would shift from walk-in field training opportunities to limited access on the levee sections that remain and possibly in new estuary area under certain tidal cycles.

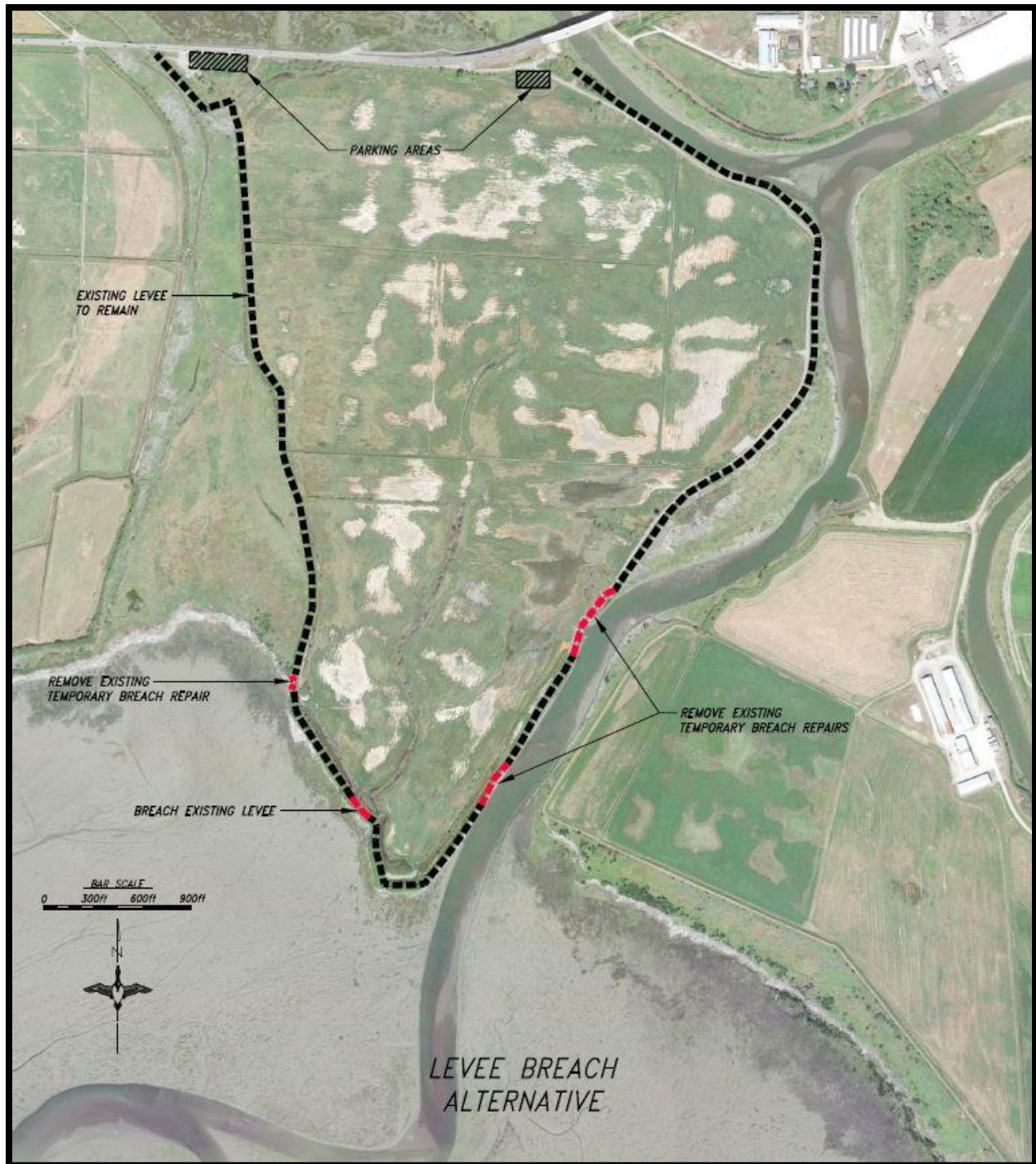
***Educational and Research Opportunity (✓)***

All alternatives will provide interesting educational and research opportunities.

***Salmon Recovery Consistency: (Yes)***

This design alternative contributes towards goals outlined in the *Stillaguamish Watershed Chinook Salmon Recovery Plan* (June 2005). Restoration of estuary habitat on Leque Island is specifically identified as the top priority nearshore/estuary project in the plan.

## Levee Breach Alternative (Scenario 2 in the Modeling Report)



### ***Design Description***

The “Levee Breach” design alternative includes leaving the current levee system in place around the perimeter of Leque Island that is south of Highway 532, with the exception of the materials installed as temporary repairs in 2010 and one additional breach at the outlet of the main relict channel on the site.

In this design alternative, the entire site would be open to tidal inundation. Tidal processes would be somewhat muted due to the relatively small openings in the levee system, though less muted than the “Do Nothing” alternative. Over time, the openings in the levee system would likely expand and the degree of tidal muting would decrease. Two parking areas could be developed adjacent to Highway 532, if funding secured to complete the project is able to cover this cost.

### ***Screening Criteria Analysis***

#### ***Funding Source Potential – Highly Likely***

The cost estimate for constructing this alternative is \$1.2 million, not including permit and compensatory replacement land costs. This estimate is very preliminary, as details influencing cost would be determined in the subsequent design phase. Due to consistency with salmon recovery priorities and the low cost of constructing this design alternative, it is highly likely that external grant sources dedicated to salmon recovery and habitat restoration would fund implementation.

#### ***Permit Potential – Low Cost***

No significant costs or barriers to receiving permits to implement this design alternative are foreseen at this time. This project is consistent with permit provisions outlined by the Army Corps of Engineers as part of the authorization to install the temporary repairs in 2010.

#### ***WDFW Contractual Obligations – NAWCA Replacement Lands***

In 1993, WDFW was awarded a grant through the North American Wetland Conservation Act (NAWCA) administered by the U.S. Fish and Wildlife Service (USFWS) to acquire properties in Skagit County. As part of that grant award, WDFW used a portion of Leque Island as leverage or “match” in order to receive the NAWCA grant. Language in the grant contract between WDFW and USFWS indicates that the portion of Leque Island used as match for the NAWCA grant shall remain as farmed forage for snow geese unless otherwise approved by NAWCA. This design alternative would not allow WDFW to continue to plant snow goose forage on the portion of Leque Island used as NAWCA match. At this time, NAWCA personnel have indicated that implementing this design alternative will require WDFW to provide a long-term replacement for snow goose forage on a property within a reasonable vicinity and comparable acreage to the NAWCA match properties. At the time of construction, WDFW would need to have a plan in place and timeline for providing this replacement.

#### ***Neighboring Property Impact – None***

A study completed by Pacific Groundwater Group in 2012 titled “A Hydrogeologic Evaluation of Proposed Restoration of Leque Island”, and subsequent confirmation from the U.S. Environmental Protection Agency (EPA) indicate that implementation of this design alternative does not increase risk to adjacent drinking water aquifers. WDFW and DU are continuing to monitor water quality parameters as requested by Juniper Beach Water District, and will continue to do so if this alternative is selected for implementation.

Results from the initial hydrodynamic model indicate that there is nothing of obvious concern that would eliminate this design from consideration. If this design is selected, specific points of interest will be identified in the Stillaguamish River channel and the model will be reapplied to more closely examine velocities and bed shear forces in the vicinity of adjacent properties. This work will be completed in the subsequent design and study phase for the project.

**Screening Criteria Result:** *(Eliminated or **Advanced**)*

### ***Additional Considerations Analysis***

#### ***Salmon Habitat Availability (+)***

Results of the hydrodynamic model indicate that the entire site would be inundated by tidal water for amounts of time desirable for salmon rearing at desired salinity levels, which is an improvement over the current site condition. However, the relatively small openings in the levee limit salmon accessibility to the site and would mute habitat forming processes, especially channel formation. Channels and habitat connectivity are important for salmon rearing, thus this design did not receive the highest possible rating in this category. This alternative ranks higher in this category than the “Do Nothing” alternative because the degree of muting in this alternative is less and there is one additional dike breach that would provide additional habitat connectivity.

#### ***Other ESA-listed Species Habitat Availability (+)***

For the purpose of this document, there are four species listed as threatened or endangered in the Endangered Species Act (ESA) with the potential to be impacted directly or indirectly by this project. They are steelhead, bull trout, marbled murrelet, and orca whales. The increase in area of estuary habitat provided by this design is more beneficial to these species than the current condition of the site. The impaired accessibility to the site due to the small openings in the breaches prevents this alternative from receiving the highest rating.

#### ***Non-ESA listed Species Effects (+/-)***

Restoring tidal flooding to the site will provide habitat for a different suite of species than the current conditions. Upland species will likely be displaced to other sites, while species adapted to estuary conditions will expand onto the site. As a result, this alternative was given neither a positive or negative value. It is also understood that conditions will not be comparable to the existing state of the site, so a  $\sqrt{\phantom{x}}$  value is not appropriate. A +/- rating is assigned because there are positive effects for some species and negative effects for others, and it is assumed that there is no definite overall positive or negative net effect.

#### ***Property Maintenance (-)***

A monitoring and adaptive management plan would need to be developed to identify action points for maintenance of this design. Fish monitoring and vegetation monitoring would be helpful to ensure that beneficial habitat conditions exist and that invasive plant species do not

dominate the system. Because the degree of tidal restoration would likely shift over time as the breaches expand, property maintenance activities may need to shift over time to adapt to changing conditions.

Modification to existing infrastructure such as the removal of hardened features such as the Eide Road parking, county road way and drainage ditches have not been examined so no costs have been determined. The costs associated with the monitoring and adaptive management measures have not been developed for this alternative but would be discussed if this design is chosen to move forward to implementation.

#### ***Natural Processes Restored (+)***

The hydrodynamic model indicates that hydraulic tidal processes would be restored to the entire site, though tidal processes would be muted in the short term due to relatively small openings in the levee. In addition to hydraulic processes simulated by the model, other natural processes need to be considered under this criterion. Several studies and scientific documents, including the 2013 WDFW Water Crossing Design Guidelines, indicate that geomorphic and sedimentary processes are affected by the size of dike breach openings. Some of these natural processes include sediment transport, large wood accumulation, and channel migration. Restoration of these underlying natural processes is necessary to maintain desired habitat structures and functions in the long-term, including a dynamic network of channels, marsh vegetation, and complex large wood structures. This alternative presents an improvement compared to current conditions, though it does not receive the highest possible rating because of muted effects in natural processes due to the relatively small breach openings. This alternative ranks slightly higher than the Do Nothing alternative.

#### ***Compatibility with Climate Change (+)***

The existing levees on the site overtop occasionally, and will continue to overtop with more frequency according to models that project sea level rise. This alternative presents an improvement over the current condition because there WDFW would no longer attempt to restrict tidal flows from the site using the existing undersized levees. The alternative does not receive the highest possible rating because portions of the remaining levee would remain on site.

#### ***Waterfowl Hunting Opportunity and Access (+/-)***

The site would remain open to waterfowl hunting, and the estuary habitats projected to form on the site over time are important habitats for waterfowl. Recent studies have indicated that restoration of estuary habitat significantly benefits waterfowl populations. Hunting access on the property would shift from walk-in field hunting to walk-in or boat-in intertidal estuary hunting. Depending on the style of hunting preferred by an individual waterfowl hunter, this change could be seen as a positive or negative impact to hunting opportunity and access.

#### ***Pheasant Hunting Opportunity and Access (- -)***

Because of the restoration of tidal inundation on the entire site, the site would no longer be able to support pheasant releases and hunting. WDFW will work to identify and secure an alternative site that can be used for pheasant hunting.

***Wildlife Viewing and Photography Opportunity and Access (–)***

Wildlife viewing and photography opportunities will still be available on the site however, with the shift in habitat to estuarine conditions on the entire site, species that prefer upland habitats would no longer be present as consistently on the site. Walk-in access would be limited to sections of the dike that are not removed, though boat-in access may provide unique viewing and photography opportunities and some walk-in access may be possible on the site depending on the tide level.

***Dog Training Opportunity and Access (–)***

The site would shift from walk-in field training opportunities to limited access on the levee sections that remain and possibly in new estuary area under certain tidal cycles.

***Educational and Research Opportunity (✓)***

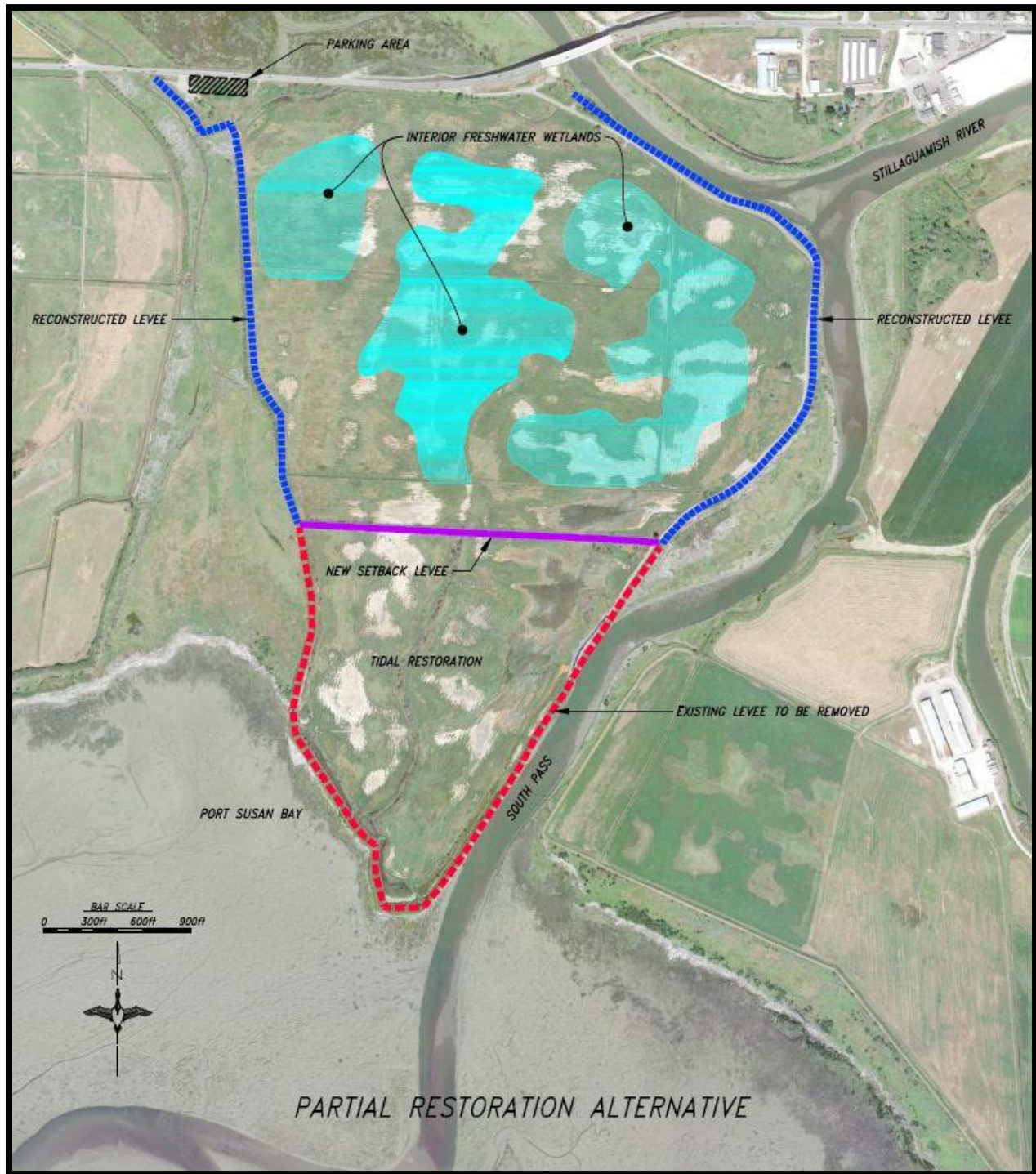
All alternatives will provide interesting educational and research opportunities.

***Salmon Recovery Consistency: (Yes)***

This design alternative contributes towards goals outlined in the *Stillaguamish Watershed Chinook Salmon Recovery Plan* (June 2005). Restoration of estuary habitat on Leque Island is specifically identified as the top priority nearshore/estuary project in the plan.



## Setback Dike Alternative (Scenarios 1 and 5 in the Modeling Report)



### ***Design Description***

The "Setback Dike" design alternative includes building a new setback dike in an east-west orientation across the site and reconstructing the levees running in a north-south orientation. In this design



alternative, approximately 115 acres of the site would be open to tidal inundation and the remainder would be protected from tidal processes by the new levee system. Management of the portion of the site not subjected to tidal processes would be decided in future design stages, and may include freshwater wetlands and/or agriculture components. Car access to the site could be accommodated along or near Eide Road and in a parking area adjacent to Highway 532. Other restoration and recreation access design features would be developed in later design phases.

### ***Screening Criteria Analysis***

#### ***Funding Source Potential – Uncertain***

The cost estimate for constructing this alternative is \$9.3 million, not including permit and compensatory mitigation costs. This estimate is very preliminary, as details influencing cost would be determined in the subsequent design phase. The majority of the cost associated with this alternative is construction of the levees. Due to the tidal restoration element of this project, it is possible that external grant sources dedicated to salmon recovery and habitat restoration would be interested in funding implementation. All grants, however, are awarded in competitive processes. To be successful, the project should demonstrate a high benefit-to-cost ratio compared to other competing projects. Given the high cost of this design alternative, and less than maximum benefit to salmon recovery and habitat restoration, there is some uncertainty as to whether or not this design alternative will be successful in competitive grant processes.

#### ***Permit Potential – Low Cost, some uncertainty***

No significant costs or barriers to receiving permits to implement this design alternative are foreseen at this time. This assessment is contingent upon the assumption that the tidal restoration component of this design will satisfy all mitigation requirements associated with construction of the setback dike and reconstructing the new levees.

#### ***WDFW Contractual Obligations – Compatible***

The tracts used as match for the 1993 NAWCA grant are located landward of the proposed setback dike, and it would remain possible to grow snow goose forage on those tracts. Implementation of this design alternative is compatible with all contracts associated with the original fund sources associated with the property acquisitions of Leque Island.

#### ***Neighboring Property Impact – None***

A study completed by Pacific Groundwater Group in 2012 titled “A Hydrogeologic Evaluation of Proposed Restoration of Leque Island”, and subsequent confirmation from the U.S. Environmental Protection Agency (EPA) indicate that implementation of this design alternative does not increase risk to adjacent drinking water aquifers. WDFW and DU are continuing to monitor water quality parameters as requested by Juniper Beach Water District, and will continue to do so if this alternative is selected for implementation.

Results from the initial hydrodynamic model indicate that there is nothing of obvious concern that would eliminate this design from consideration. If this design is selected, specific points of interest will be identified in the Stillaguamish River channel and the model will be reapplied to more closely examine velocities and bed shear forces in the vicinity of adjacent properties. This work will be completed in the subsequent design and study phase for the project.

**Screening Criteria Result:** (Eliminated or **Advanced**)

### ***Additional Considerations Analysis***

#### ***Salmon Habitat Availability (+)***

Results of the hydrodynamic model indicate that the 115 acre portion of the site waterward of the setback dike would be inundated by tidal water for amounts of time desirable for salmon rearing at desired salinity levels. Restoration of estuary habitat is listed as top priority in the Stillaguamish Basin Chinook Salmon Recovery Plan. The portion of the site restored to estuary would be fully accessible to juvenile salmon and open to habitat forming tidal processes that are beneficial for salmon. This alternative does not receive the highest rating because it does not restore the entire site to estuary.

#### ***Other ESA-listed Species Habitat Availability (+)***

For the purpose of this document, there are four species listed as threatened or endangered in the Endangered Species Act (ESA) with the potential to be impacted directly or indirectly by this project. They are steelhead, bull trout, marbled murrelet, and orca whales. The increase in area of estuary habitat provided by this design is more beneficial to these species than the current condition of the site. This alternative does not receive the highest rating because it does not restore the entire site to estuary.

#### ***Non-ESA listed Species Effects (+)***

This alternative was given a positive value because several habitat types will be available in this design that will support a diverse array of species. The site will support freshwater wetland, estuary and tidal marsh, as well as possibly some forage grown for waterfowl species.

#### ***Property Maintenance (+)***

This project would provide a new and improved dike and levee system that would reduce current dike repair cost, and would also likely improve water management capabilities in the area protected by the setback dike. Dike maintenance costs would still exist long-term and become part of the Wildlife Area operation and management budget. This would include vegetation management, weed control and monitoring infrastructure. These costs would be necessary to protect the new infrastructure. A monitoring and adaptive management plan would need to be developed to identify potential action points for maintenance of the restoration area. Fish monitoring and vegetation monitoring would be helpful to ensure that beneficial habitat conditions exist and that invasive species plant species do not dominate the system. Cost related

to other site management would be determined based on the management plan developed during next design phase if this alternative is selected to move forward.

***Natural Processes Restored (+)***

Natural tidal processes would be restored to the 115 acre portion of the site waterward of the setback levee, though the new levees would prevent restoration of tidal processes on the remainder of the site. Because the levee would be completely removed in the portion of the site restored to estuary, the hydrodynamic model does not indicate that tidal processes would be muted in the restored area, and the trajectory of channel formation, marsh vegetation development, and other habitat forming processes would be faster than the Do Nothing or Levee Breach alternatives. Although this alternative significantly restores natural processes in the estuary restoration area, it does not receive the highest possible rating because the setback dike will restrict tidal processes from the majority of the site.

***Compatibility with Climate Change (+/-)***

This design alternative is considered to have a neutral in this category because a portion of the site will continue to be protected from tidal inundation with a setback dike and levees. A  $\nabla$  value is not assigned in this category because the levee system will be in a different location than it is currently, and will be reinforced for extend its projected life span.

***Waterfowl Hunting Opportunity and Access (+)***

This alternative is ranked as positive in this category. The entire site would remain open to waterfowl hunting. Estuary habitats projected to form in the southern portion of the site are important habitats for waterfowl. Recent studies have indicated that restoration of estuary habitat significantly benefits waterfowl populations. Additionally, a freshwater wetland/agriculture component on the property will persist on the northern portion of the site. The property will provide walk-in field hunting as well as walk-in or boat-in intertidal hunting.

***Pheasant Hunting Opportunity and Access (- -)***

Because of the restoration of tidal inundation to 115 acres of the site, the remainder of the site would likely not be large enough to support pheasant releases and pheasant hunting. WDFW will work to identify and secure an alternative site that can be used for pheasant hunting.

***Wildlife Viewing and Photography Opportunity and Access (+ +)***

This alternative is ranked as the highest possible score in this category because the site would continue to have habitats that support upland species, as well as estuary habitat within a short distance from the parking area that would support estuarine species. The new setback dike and reconstructed levees would likely provide a dike-top trail for easy walking access around the perimeter of the site.

***Dog Training Opportunity and Access (+/-)***

The portion of the site landward of the setback dike will continue to be available for dog training activities as it is currently. This area is assumed to be large enough to support all dog training activities on the site.

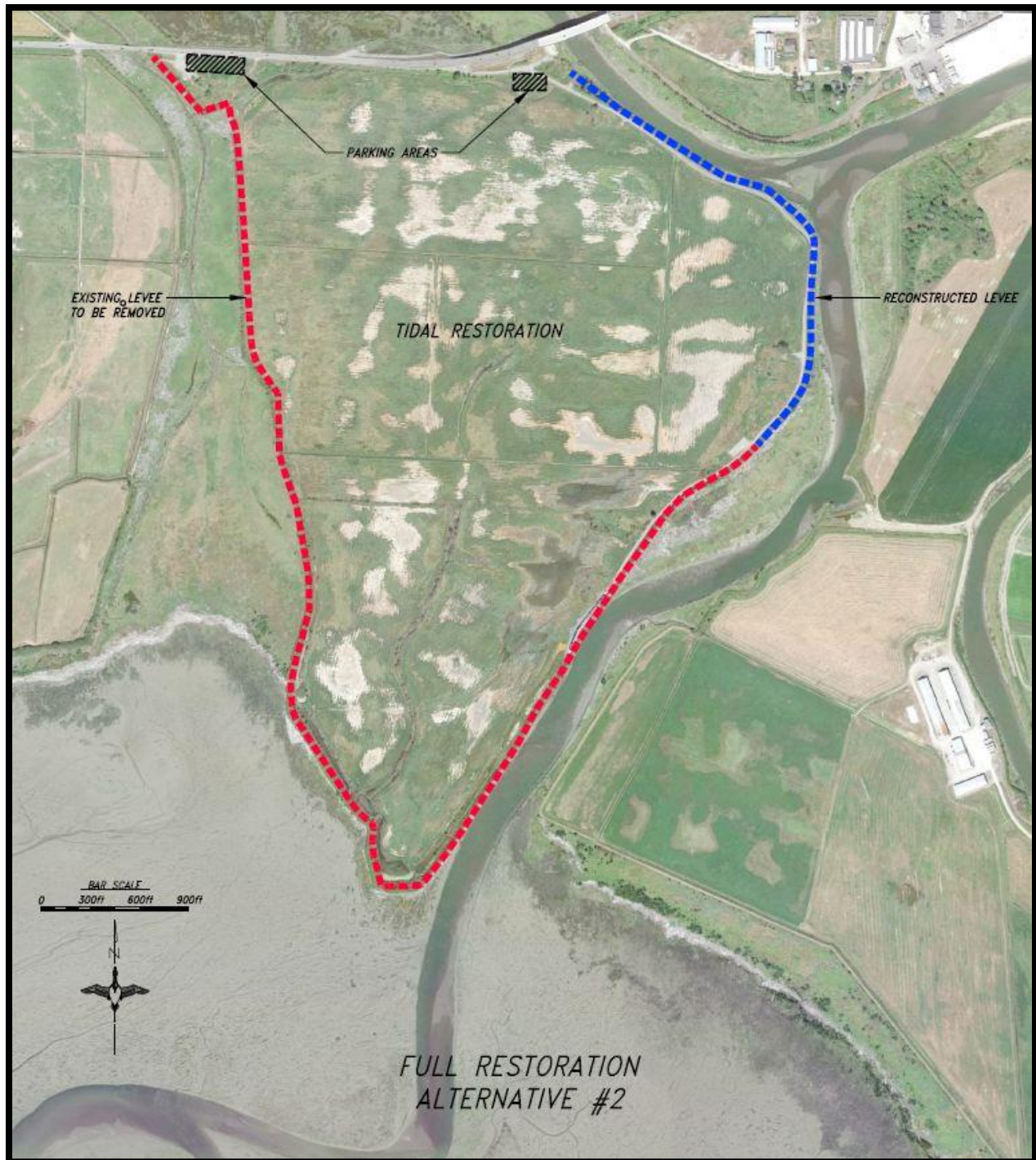
***Educational and Research Opportunity (v)***

All alternatives will provide interesting educational and research opportunities.

***Salmon Recovery Consistency: (Yes)***

This design alternative contributes towards goals outlined in the *Stillaguamish Watershed Chinook Salmon Recovery Plan* (June 2005). Restoration of estuary habitat on Leque Island is specifically identified as the top priority nearshore/estuary project in the plan.

## Training Dike Alternative (Scenarios 4 and 6 in the Modeling Report)



### ***Design Description***

The "Training Dike" design alternative includes removing the current levee system around the perimeter of site, and reconstructing a portion of levee on the eastern portion of the site, referred to as a "training dike". In this design alternative, the entire site would be open to tidal inundation. The training dike

would provide a level of assurance that the river channel will not migrate westward through the site, and could also provide a trail for walk-in recreation access. Restoration and recreation design features, such as construction of pilot channels and a vegetation plan would be developed at a later design stage. Two parking areas could be developed adjacent to Highway 532 if grant funding secured to implement the project is able to cover this cost.

### ***Screening Criteria Analysis***

#### ***Funding Source Potential – Highly Likely***

The cost estimate for constructing this alternative is \$5.3 million, not including permit and compensatory replacement land costs. This estimate was is very preliminary, as details influencing cost would be determined in the subsequent design phase. Due to consistency with salmon recovery priorities and the low cost of constructing this design alternative, it is highly likely that external grant sources dedicated to salmon recovery and habitat restoration would fund implementation.

#### ***Permit Potential – Low Cost***

No significant costs or barriers to receiving permits to implement this design alternative are foreseen at this time.

#### ***WDFW Contractual Obligations – NAWCA Replacement Lands***

In 1993, WDFW was awarded a grant through the North American Wetland Conservation Act (NAWCA) administered by the U.S. Fish and Wildlife Service (USFWS) to acquire properties in Skagit County. As part of that grant award, WDFW used a portion of Leque Island as leverage or “match” in order to receive the NAWCA grant. Language in the grant contract between WDFW and USFWS indicates that the portion of Leque Island used as match for the NAWCA grant shall remain as farmed forage for snow geese unless otherwise approved by NAWCA. This design alternative would not allow WDFW to continue to plant snow goose forage on the portion of Leque Island used as NAWCA match. At this time, NAWCA personnel have indicated that implementing this design alternative will require WDFW to provide a long-term replacement for snow goose forage on a property within a reasonable vicinity and comparable acreage to the NAWCA match properties. At the time of construction, WDFW would need to have a plan in place and timeline for providing this replacement. Funding is not currently in place to meet this requirement.

#### ***Neighboring Property Impact – None***

A study completed by Pacific Groundwater Group in 2012 titled “A Hydrogeologic Evaluation of Proposed Restoration of Leque Island”, and subsequent confirmation from the U.S. Environmental Protection Agency (EPA) indicate that implementation of this design alternative does not increase risk to adjacent drinking water aquifers. WDFW and DU are continuing to monitor water quality parameters as requested by Juniper Beach Water District, and will continue to do so if this alternative is selected for implementation.

Results from the initial hydrodynamic model indicate that there is nothing of obvious concern that would eliminate this design from consideration. Although, the model did predict some potential changes to velocity and bed shear on the east side of the Stillaguamish River, opposite the Leque Island restoration area. The training dike feature reduces these changes to velocity and bed shear, as compared to the full restoration alternative. If this design is selected, specific points of interest will be identified in the Stillaguamish River channel and the model will be reapplied to more closely examine velocities and bed shear forces in the vicinity of adjacent properties. This work will be completed in the subsequent design and study phase for the project.

**Screening Criteria Result:** (Eliminated or **Advanced**)

### ***Additional Considerations Analysis***

#### ***Salmon Habitat Availability (+ +)***

Results of the hydrodynamic model indicate that the entire site would be inundated by tidal water for amounts of time desirable for salmon rearing at desired salinity levels. Restoration of estuary habitat is listed as top priority in the Stillaguamish Basin Chinook Salmon Recovery Plan. The majority of the site provides unimpeded access to critical estuary habitats that would develop on the entire site. The training dike would be an access barrier to some juvenile salmon entering the site, so this alternative is slightly less beneficial to salmon recovery than the Full Dike Removal alternative.

#### ***Other ESA-listed Species Habitat Availability (+ +)***

For the purpose of this document, there are four species listed as threatened or endangered in the Endangered Species Act (ESA) with the potential to be impacted directly or indirectly by this project. They are steelhead, bull trout, marbled murrelet, and orca whales. The increase in area of estuary habitat provided by this design is more beneficial to these species than the current condition of the site. The majority of the site provides unimpeded access to estuary habitats that would develop on the entire site. The training dike would be an access barrier to some species entering the site, so this alternative is slightly less beneficial than the Full Dike Removal alternative.

#### ***Non-ESA listed Species Effects (+/-)***

Restoring tidal flooding to the site will provide habitat for a different suite of species than the current conditions. Upland species will likely be displaced to other sites, while species adapted to estuary conditions will expand onto the site. As a result, this alternative was given neither a positive or negative value. It is also understood that conditions will not be comparable to the existing state of the site, so a  $\sqrt{\phantom{x}}$  value is not appropriate. A +/- rating is assigned because there are positive effects for some species and negative effects for others, and it is assumed that there is no definite overall positive or negative net effect.



***Property Maintenance (+)***

This project would remove the need to maintain the majority of the dike system, though some maintenance would be necessary on the new training dike infrastructure. The modification to existing infrastructure such as the removal or improvement of hardened features such as the Eide Road parking, county road way and drainage ditches have not been examined so no costs have been determined. Fish monitoring and vegetation monitoring would be helpful to ensure that beneficial habitat conditions exist and that no invasive species develop in the system.

A monitoring and adaptive management plan would need to be developed to identify potential action points for maintenance of the restoration area. The costs associated with the monitoring and adaptive management measures have not been developed for this alternative but would be discussed if this design is chosen to move forward to implementation.

***Natural Processes Restored (+ +)***

With the levees removed around the majority of the site, natural tidal processes would be restored and nearly unrestricted on the entire site. Tidal processes would form tidal channels, recruit marsh vegetation, and transport sediment, nutrients, and organic debris to and from the project site. This alternative receives the highest rating because of the scale of natural process restoration on the site, but falls slightly below the Full Dike Removal alternative because the training dike would restrict a portion of tidal flow, sediment transport, and would reduce habitat connectivity.

***Compatibility with Climate Change (+)***

This alternative presents an improvement over the current condition because there WDFW would no longer attempt to restrict tidal flows from the site using the existing undersized levees. The alternative does not receive the highest possible rating because the training dike will be subjected to rising sea levels, and over time, may need to be elevated.

***Waterfowl Hunting Opportunity and Access (+/-)***

The site would remain open to waterfowl hunting, and the estuary habitats projected to form on the site over time are important habitats for waterfowl. Recent studies have indicated that restoration of estuary habitat significantly benefits waterfowl populations. Hunting access on the property would shift from walk-in field hunting to walk-in or boat-in intertidal estuary hunting. Depending on the style of hunting preferred by an individual waterfowl hunter, this change could be seen as a positive or negative impact to hunting opportunity and access.

***Pheasant Hunting Opportunity and Access( - -)***

Because of the restoration of tidal inundation on the entire site, the site would no longer be able to support pheasant releases and hunting. WDFW will work to identify and secure an alternative site that can be used for pheasant hunting.

***Wildlife Viewing and Photography Opportunity and Access ( -)***



Wildlife viewing and photography opportunities will still be available on the site however, with the shift in habitat to estuarine conditions on the entire site, species that prefer upland habitats would no longer be present as consistently on the site. Walk-in access would be limited to the training dike, though boat-in access may provide unique viewing and photography opportunities and some walk-in access may be possible on the site depending on the tide level.

***Dog Training Opportunity and Access (- -)***

The site would shift from walk-in field training opportunities to limited access on the training dike and possibly in the new estuary area under certain tidal cycles.

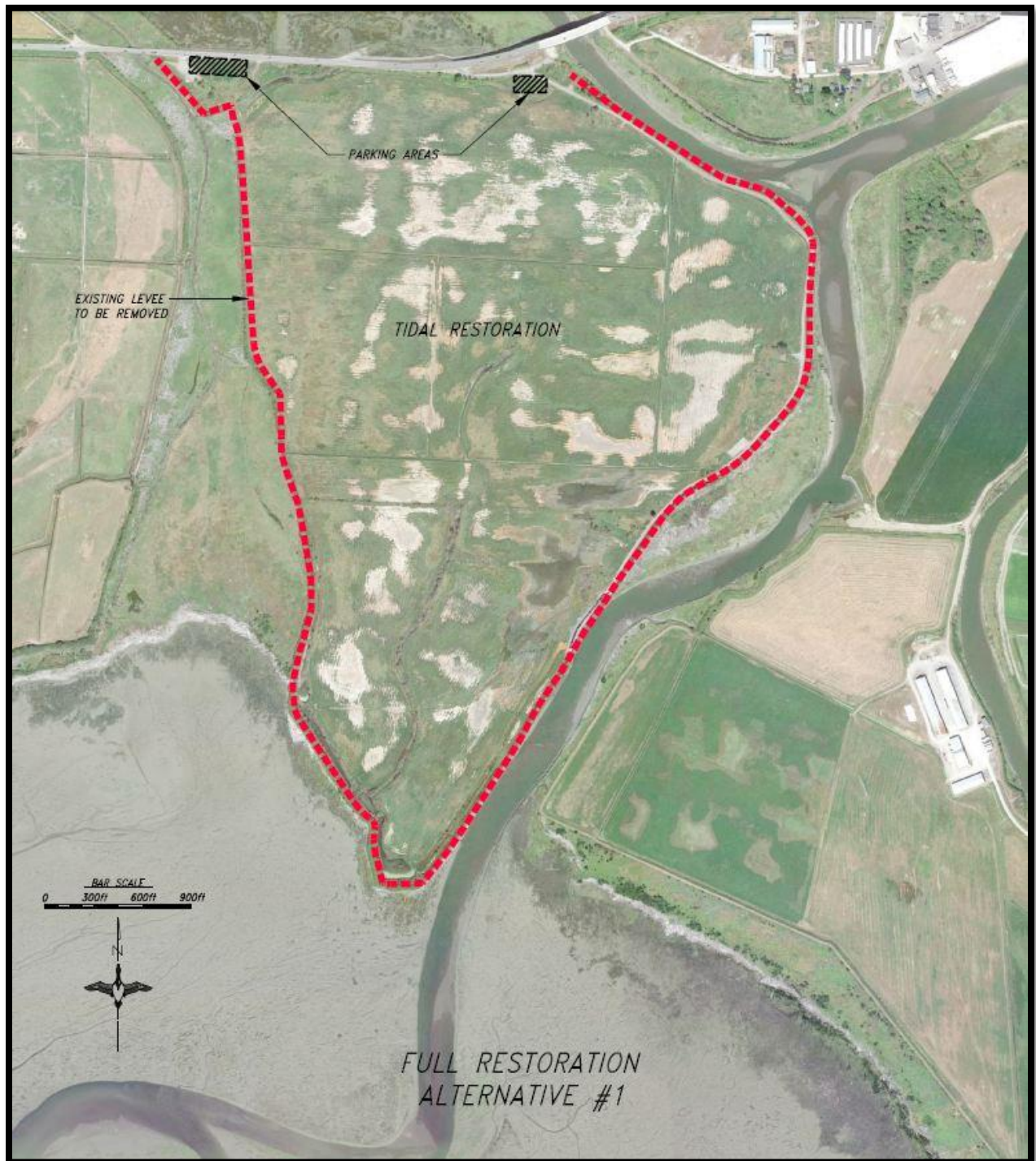
***Educational and Research Opportunity (✓)***

All alternatives will provide interesting educational and research opportunities.

***Salmon Recovery Consistency: (Yes)***

This design alternative contributes towards goals outlined in the *Stillaguamish Watershed Chinook Salmon Recovery Plan* (June 2005). Restoration of estuary habitat on Leque Island is specifically identified as the top priority nearshore/estuary project in the plan.

Full Dike Removal Alternative (Scenarios 3 and 7 in the Modeling Report)



### ***Design Description***

The “Full Dike Removal” design alternative includes removing the current levee system around the perimeter of site. In this design alternative, the entire site would be open to unimpeded tidal processes. Restoration and recreation design features, such as construction of pilot channels and a vegetation plan would be developed at a later design stage. Two parking areas could be developed adjacent to Highway 532 if grant funding secured to implement the project is able to cover this cost.

### ***Screening Criteria Analysis***

#### ***Funding Source Potential – Highly Likely***

The cost estimate for constructing this alternative is \$3.6 million, not including permit and compensatory replacement land costs. This estimate was is very preliminary, as details influencing cost would be determined in the subsequent design phase. Due to consistency with salmon recovery priorities and the low cost of constructing this design alternative, it is highly likely that external grant sources dedicated to salmon recovery and habitat restoration would fund implementation.

#### ***Permit Potential – Low Cost***

No significant costs or barriers to receiving permits to implement this design alternative are foreseen at this time.

#### ***WDFW Contractual Obligations – NAWCA Replacement Lands***

In 1993, WDFW was awarded a grant through the North American Wetland Conservation Act (NAWCA) administered by the U.S. Fish and Wildlife Service (USFWS) to acquire properties in Skagit County. As part of that grant award, WDFW used a portion of Leque Island as leverage or “match” in order to receive the NAWCA grant. Language in the grant contract between WDFW and USFWS indicates that the portion of Leque Island used as match for the NAWCA grant shall remain as farmed forage for snow geese unless otherwise approved by NAWCA. This design alternative would not allow WDFW to continue to plant snow goose forage on the portion of Leque Island used as NAWCA match. At this time, NAWCA personnel have indicated that implementing this design alternative will require WDFW to provide a long-term replacement for snow goose forage on a property within a reasonable vicinity and comparable acreage to the NAWCA match properties. At the time of construction, WDFW would need to have a plan in place and timeline for providing this replacement. Funding is not currently in place to meet this requirement.

#### ***Neighboring Property Impact – None***

A study completed by Pacific Groundwater Group in 2012 titled “A Hydrogeologic Evaluation of Proposed Restoration of Leque Island”, and subsequent confirmation from the U.S. Environmental Protection Agency (EPA) indicate that implementation of this design alternative does not increase risk to adjacent drinking water aquifers. WDFW and DU are continuing to monitor water quality

parameters as requested by Juniper Beach Water District, and will continue to do so if this alternative is selected for implementation.

Results from the initial hydrodynamic model indicate that there is nothing of obvious concern that would eliminate this design from consideration. Although, the model did predict some potential changes to velocity and bed shear on the east side of the Stillaguamish River, opposite the Leque Island restoration area. If this design is selected, specific points of interest will be identified in the Stillaguamish River channel and the model will be reapplied to more closely examine velocities and bed shear forces in the vicinity of adjacent properties. This work will be completed in the subsequent design and study phase for the project.

**Screening Criteria Result:** (Eliminated or **Advanced**)

### ***Additional Considerations Analysis***

#### ***Salmon Habitat Availability (+ +)***

Results of the hydrodynamic model indicate that the entire site would be inundated by tidal water for amounts of time desirable for salmon rearing at desired salinity levels. Restoration of estuary habitat is listed as top priority in the Stillaguamish Basin Chinook Salmon Recovery Plan. The majority of the site provides unimpeded access to critical estuary habitats that would develop on the entire site. This alternative is the most beneficial to salmon recovery.

#### ***Other ESA-listed Species Habitat Availability (+ +)***

For the purpose of this document, there are four species listed as threatened or endangered in the Endangered Species Act (ESA) with the potential to be impacted directly or indirectly by this project. They are steelhead, bull trout, marbled murrelet, and orca whales. The increase in area of estuary habitat provided by this design is more beneficial to these species than the current condition of the site. The entire site provides unimpeded access to estuary habitats that would develop on the entire site. This alternative is the most beneficial to ESA-listed species recovery.

#### ***Non-ESA listed Species Effects (+/-)***

Restoring tidal flooding to the site will provide habitat for a different suite of species than the current conditions. Upland species will likely be displaced to other sites, while species adapted to estuary conditions will expand onto the site. As a result, this alternative was given neither a positive or negative value. It is also understood that conditions will not be comparable to the existing state of the site, so a √ value is not appropriate. A +/- rating is assigned because there are positive effects for some species and negative effects for others, and it is assumed that there is no definite overall positive or negative net effect.

#### ***Property Maintenance (+)***

This project would remove existing infrastructure, and eliminate associated maintenance costs. A monitoring and adaptive management plan would need to be developed to identify potential

action points for maintenance of the restoration area. Fish monitoring and vegetation monitoring would be helpful to ensure that beneficial habitat conditions exist and that no invasive species develop in the system. Because there will continue to be maintenance costs associated with the restoration area, no design alternatives receive the maximum rating.

***Natural Processes Restored (+ +)***

With the levees removed around the majority of the site, natural tidal processes would be restored and nearly unrestricted on the entire site. Tidal processes would form tidal channels, recruit marsh vegetation, and transport sediment, nutrients, and organic debris to and from the project site. This alternative ranks highest among the other alternatives in this category.

***Compatibility with Climate Change ( + +)***

This alternative presents an improvement over the current condition because there WDFW would no longer attempt to restrict tidal flows from the site using the existing undersized levees. The alternative receives the highest possible rating because all levees on the site would be removed.

***Waterfowl Hunting Opportunity and Access (+/-)***

The site would remain open to waterfowl hunting, and the estuary habitats projected to form on the site over time are important habitats for waterfowl. Recent studies have indicated that restoration of estuary habitat significantly benefits waterfowl populations. Hunting access on the property would shift from walk-in field hunting to walk-in or boat-in intertidal estuary hunting. Depending on the style of hunting preferred by an individual waterfowl hunter, this change could be seen as a positive or negative impact to hunting opportunity and access.

***Pheasant Hunting Opportunity and Access (- -)***

Because of the restoration of tidal inundation on the entire site, the site would no longer be able to support pheasant releases and hunting. WDFW will work to identify and secure an alternative site that can be used for pheasant hunting.

***Wildlife Viewing and Photography Opportunity and Access (- -)***

Wildlife viewing and photography opportunities will still be available on the site however, with the shift in habitat to estuarine conditions on the entire site, species that prefer upland habitats would no longer be present as consistently on the site. Walk-in access would be limited to locations in close proximity to the parking areas, though boat-in access may provide unique viewing and photography opportunities and some walk-in access may be possible on the site depending on the tide level.

***Dog Training Opportunity and Access (- -)***

The site would shift from walk-in field training opportunities to limited access in close proximity to the parking areas and possibly in the new estuary area under certain tidal cycles.

***Educational and Research Opportunity (v)***

All alternatives will provide interesting educational and research opportunities.

***Salmon Recovery Consistency: (Yes)***

This design alternative contributes towards goals outlined in the *Stillaguamish Watershed Chinook Salmon Recovery Plan* (June 2005). Restoration of estuary habitat on Leque Island is specifically identified as the top priority nearshore/estuary project in the plan.

**Alternatives Analysis Summary and Conclusions**

This portion of the document will be posted in memorandum to be posted on the project webpage at: [http://wdfw.wa.gov/lands/wildlife\\_areas/skagit/leque\\_island\\_project.php](http://wdfw.wa.gov/lands/wildlife_areas/skagit/leque_island_project.php) once WDFW selects the preferred design alternative.

## Appendix A: Stakeholder Input Summary Document

Available on the project webpage at:

[http://wdfw.wa.gov/lands/wildlife\\_areas/skagit/leque\\_island\\_project.php](http://wdfw.wa.gov/lands/wildlife_areas/skagit/leque_island_project.php)

## Appendix B: List of Screening Criteria and Additional Considerations

### Screening Criteria

- Funding source(s) must be identified to pay for implementation.
- All permits required for construction must be able to be secured.
- WDFW must honor contractual obligations with fund sources used to purchase properties.
- Must not expect negative impacts to neighboring properties.

### Additional Considerations

- Salmon habitat availability.
- Other ESA-listed species habitat availability.
- Non-ESA-listed species effects.
- Long-term property maintenance costs.
- Degree of natural ecosystem process restoration.
- Compatibility with projected climate change scenarios.
- Waterfowl hunting opportunity and access.
- Pheasant hunting opportunity and access.
- Wildlife viewing/photography opportunity and access.
- Dog training opportunity and access.
- Educational/research opportunity provided by the property.
- Consistency with salmon recovery priorities.



### Appendix C: Table Summary of Design Ratings

Available on the project webpage at:

[http://wdfw.wa.gov/lands/wildlife\\_areas/skagit/leque\\_island\\_project.php](http://wdfw.wa.gov/lands/wildlife_areas/skagit/leque_island_project.php)